SILICON N-P-N "overlay" TRANSISTOR

2N5090

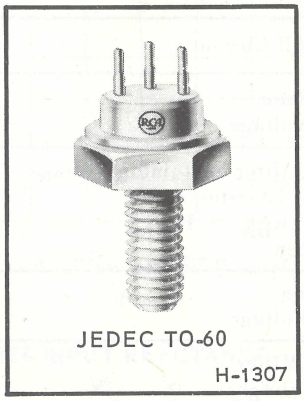
File No. 270

RCA-2N5090* is an epitaxial silicon n-p-n planar transistor employing an advanced version of the RCA-developed "overlay" emitter-electrode design. This electrode consists of many isolated emitter sites connected together through the use of a diffused-grid structure and a metal overlay which is deposited on a silicon oxide insulating layer by means of a photo-etching technique. This overlay design provides a very high emitter periphery-to-emitter area ratio resulting in low output capacitance, higher RF current handling capability, and substantially higher power gain.

The 2N5090 is intended for class-A, -B, or -C amplifier, frequency-multiplier, or oscillator circuits; it may be used in output, driver, or pre-driver stages in VHF and UHF equipment.

*Formerly RCA-Dev. No. TA7146

High-Gain Device for Class-A, B, or C Operation in VHF-UHF Circuits



JEDEC TO-60

H-1307

- 1.2 Watts Output Min. at 400 MHz (7.8 dB Gain)
- 1.6 Watts Output Typ. at 175 MHz (1.2 dB Gain)
- Isolated Electrodes

RATINGS

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	55	V
COLLECTOR-TO-EMITTER VOLTAGE:			
With external base-to-emitter resistance, R_{BE} = 10 Ω	V_{CER}	55	V
With base open	V_{CEO}	30	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	3.5	V
COLLECTOR CURRENT	I_C	0.4	A
TRANSISTOR DISSIPATION	P_T		
At case temperatures up to 75° C		5	W
At case temperatures above 75° C		*See Fig. 4.*	
TEMPERATURE RANGE:			
Storage & Operating (Junction)		−65 to 200	°C
LEAD TEMPERATURE (During soldering):			
At distances ≥ 1/32 in. from insulating wafer for 10 s max		230	°C

TYPICAL POWER OUTPUT vs. FREQUENCY

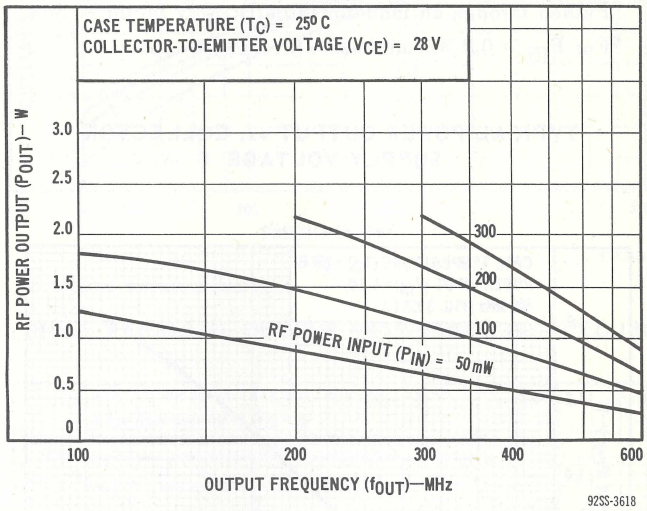


Fig. 1

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ELECTRICAL CHARACTERISTICS

Case Temperature = 25° C

Characteristic	Symbol	TEST CONDITIONS					LIMITS		Units
		DC Collector Volts		DC Current (mA)					
		V_{CB}	V_{CE}	I_E	I_B	I_C	Min.	Max.	
Collector-Cutoff Current	I_{CEO}		28		0		-	20	μA
Collector-to-Base Breakdown Voltage	BV_{CBO}			0		0.1	55	-	V
Collector-to-Emitter Sustaining Voltage With external base-to-emitter resistance (R_{BE}) = 10 Ω	V_{CER} (sus)					5	55[a]		V
With base open	V_{CEO} (sus)				0	5	30	-	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}			0.1		0	3.5	-	V
Collector-to-Emitter Saturation Voltage	V_{CE} (sat)				20	100	-	1.0	V
Collector-to-Base Capacitance (Measured at 1 MHz)	C_{ob}	30		0			-	3.5	pF
RF Power Output: As Class-C Amplifier, Unneutralized At 400 MHz *(See Fig. 3.)*	P_{OUT}		28				1.2[b]		W
Gain-Bandwidth Product	f_T		15			50	500		MHz

[a]Pulsed through an inductor (25 mH); duty factor = 50%.

[b]For P_{IN} = 0.2 W; minimum efficiency = 45%.

TYPICAL POWER OUTPUT vs. COLLECTOR SUPPLY VOLTAGE

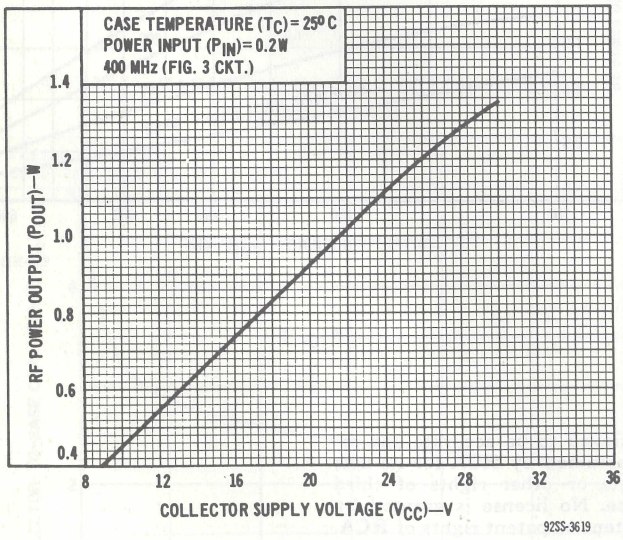
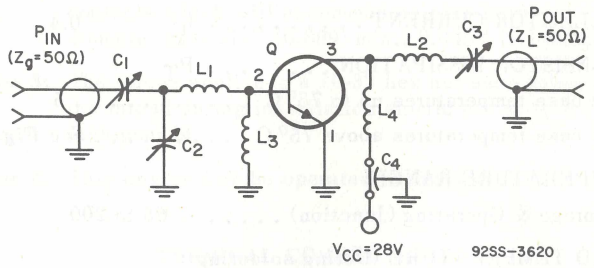


Fig. 2

RF AMPLIFIER CIRCUIT FOR 2N5090 POWER-OUTPUT TEST (400-MHz Operation)



C_1: 0.9-7 pF (ARCO 400 or equivalent)

C_2, C_3: 1.5-20 pF (ARCO 402 or equivalent)

C_4: 1,000 pF feed through

L_1: 2 turns No. 18 wire, 1/4" ID, 1/8" long

L_2: 3 turns No. 16 wire, 1/4" ID, 3/8" long

L_3: RF choke, 0.1 μH

L_4: 2 turns No. 18 wire, 1/8" ID, 2/16" long

Q: 2N5090

Fig. 3

DISSIPATION DERATING CURVE

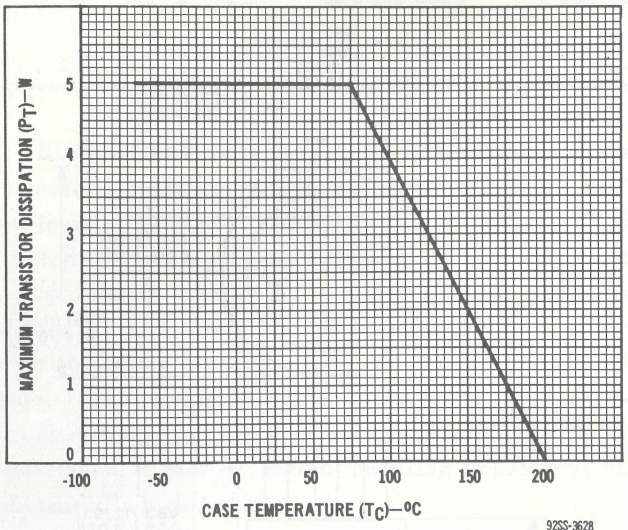


Fig. 4

TYPICAL GAIN-BANDWIDTH PRODUCT vs. COLLECTOR CURRENT

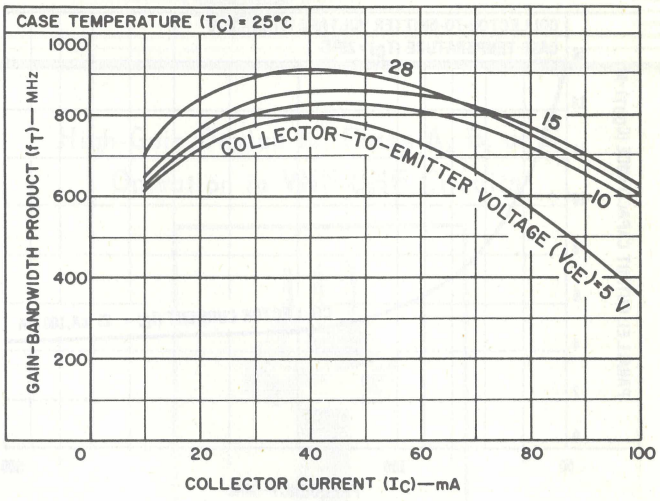


Fig. 5

TYPICAL SERIES INPUT RESISTANCE vs. FREQUENCY

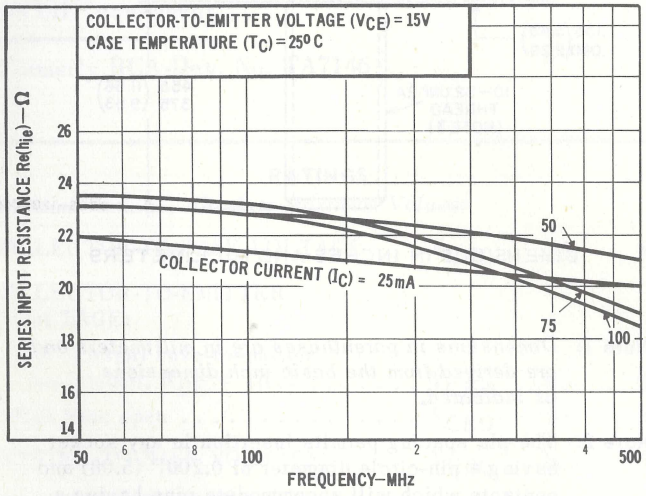


Fig. 6

TYPICAL SERIES INPUT REACTANCE vs. FREQUENCY

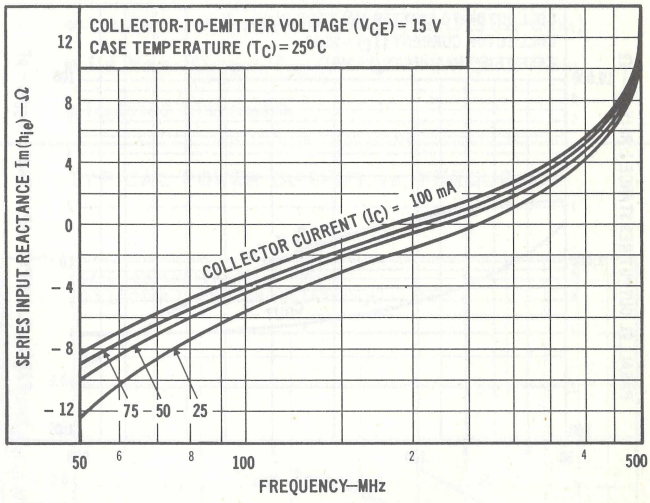


Fig. 7

TYPICAL SERIES INPUT RESISTANCE AND REACTANCE vs. FREQUENCY

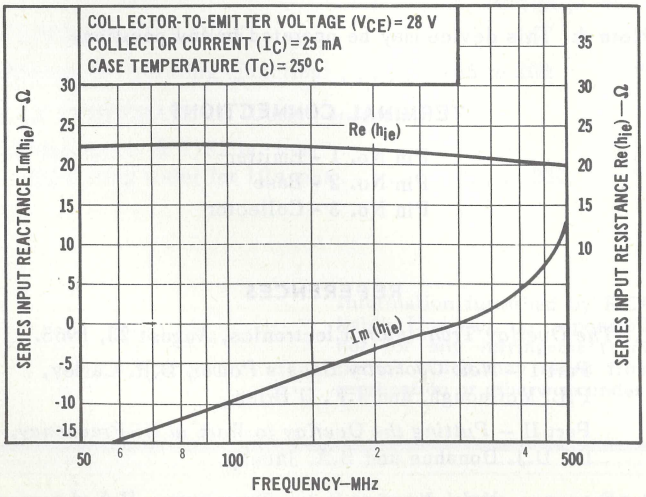


Fig. 8

TYPICAL PARALLEL OUTPUT RESISTANCE vs. FREQUENCY

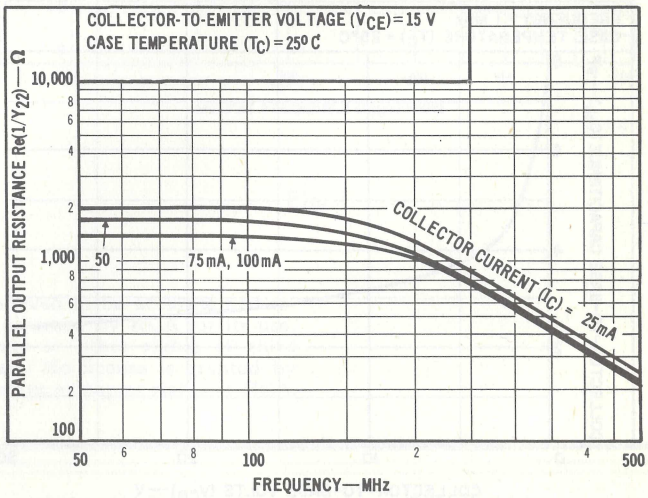


Fig. 9

TYPICAL PARALLEL OUTPUT CAPACITANCE vs. FREQUENCY

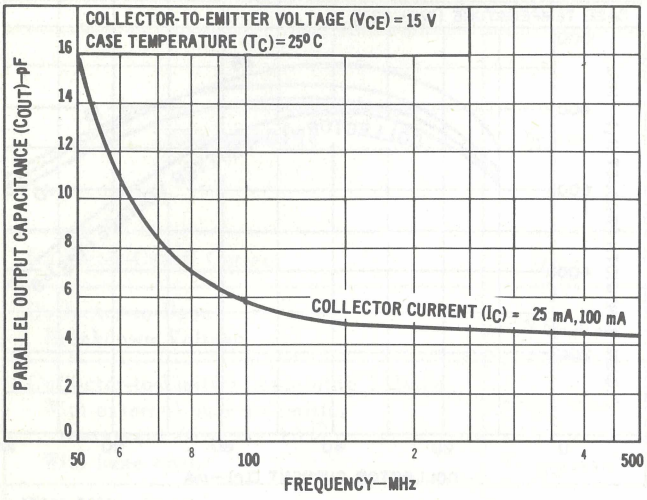

COLLECTOR-TO-EMITTER VOLTAGE (V_{CE}) = 15 V
CASE TEMPERATURE (T_C) = 25°C
PARALLEL OUTPUT CAPACITANCE (C_{OUT})—pF
COLLECTOR CURRENT (I_C) = 25 mA, 100 mA
FREQUENCY—MHz
92SS-3626

Fig. 10

TYPICAL PARALLEL OUTPUT RESISTANCE AND CAPACITANCE vs. FREQUENCY

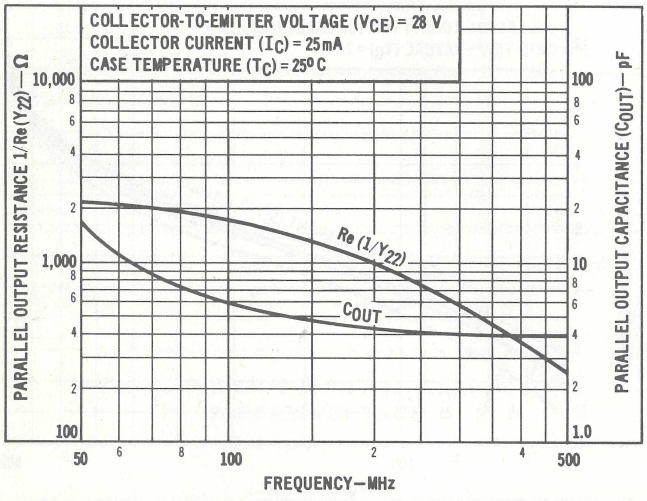


Fig. 11

TYPICAL VARIATION OF COLLECTOR-TO-BASE CAPACITANCE

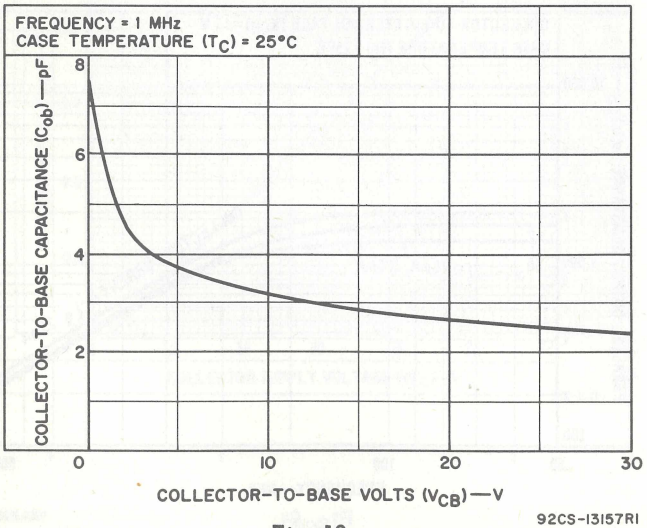
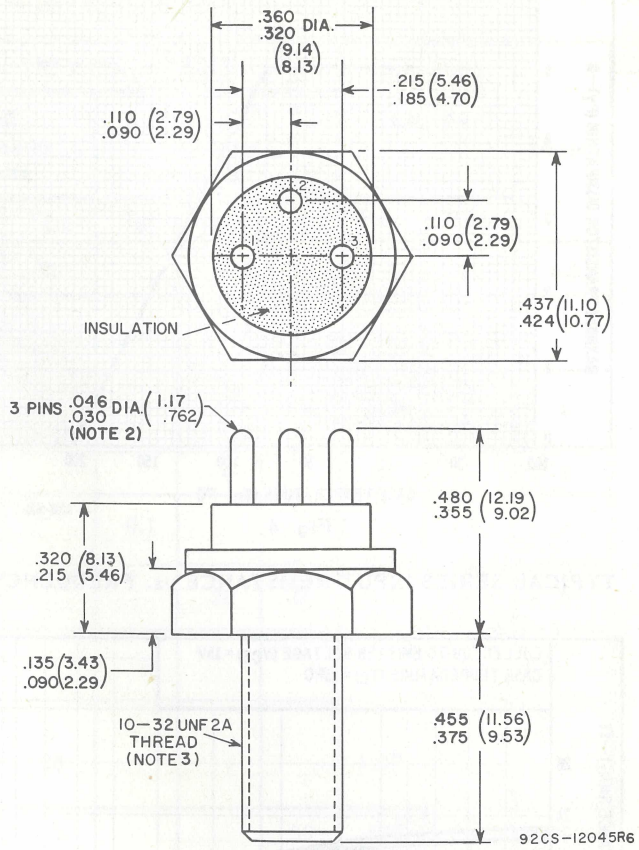


Fig. 12

DIMENSIONAL OUTLINE JEDEC TO-60



DIMENSIONS IN INCHES AND MILLIMETERS

Note 1: *Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.*

Note 2: The pin spacing permits insertion in any socket having a pin-circle diameter of 0.200" (5.08) and contacts which will accommodate pins having a diameter of 0.035" (0.889) min., 0.045" (1.143) max.

Note 3: The torque applied to a 10-32 hex nut assembled on the thread during installation should not exceed 12 inch-pounds.

Note 4: This device may be operated in any position.

TERMINAL CONNECTIONS

Pin No. 1 - Emitter
Pin No. 2 - Base
Pin No. 3 - Collector

REFERENCES

1. *The Overlay Transistor,* Electronics, August 23, 1965.
   Part I — *New Geometry Boosts Power,* D.R. Carley, P.L. McGeough, and J.F. O'Brien.
   Part II — *Putting the Overlay to Work at Hi-Frequency,* Dr. D.J. Donahue and B.A. Jacoby.
2. Frequency Multiplication Using Transistors, H.C. Lee and R. Minton, RCA Application Note SMA-40.